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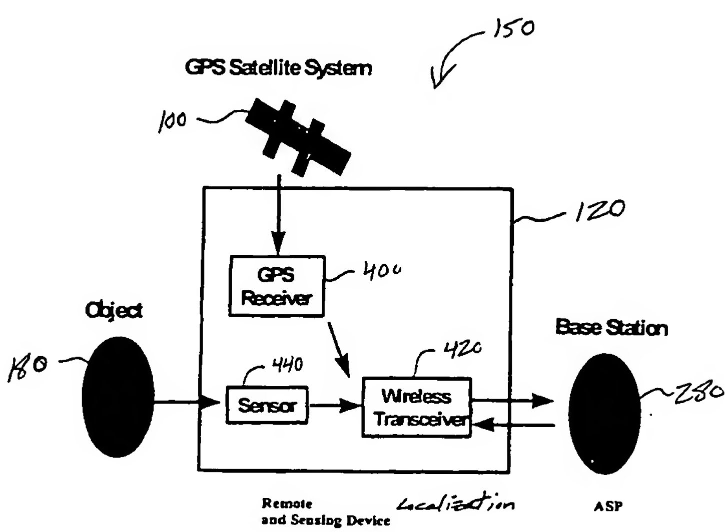
(54) Title: SHIPPING CONTAINER HAVING INTEGRAL LOCALIZATION AND SENSING DEVICE



(57) **Abstract:** A localization and sensing device for tracking and monitoring a condition of an object having a wireless positioning receiver for receiving positioning data from a wireless positioning system such as a Global Positioning System ("GPS"), and a wireless transceiver for transmitting the positioning data to a base station whereby making the positioning data available to an end user and a sensor for monitoring a desired parameter of the object and a sensor for monitoring a desired parameter of the object, wherein the sensor transmits parameter data to the wireless transceiver, and wherein the wireless transceiver transmits the parameter data to the base station whereby making the parameter data available to an end user.

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SHIPPING CONTAINER HAVING INTEGRAL LOCALIZATION AND SENSING DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

[001] This application claims priority to Provisional Patent Application Serial No. 60/318,582, filed on September 10, 2001, and, as a continuation-in-part, to U.S. Non-Provisional Patent Application Serial No. _________, filed June 27, 2002, entitled SYSTEMS AND METHODS FOR MONITORING AND TRACKING, both of which are incorporated herein by reference.

FIELD OF THE INVENTION

[002] This invention is directed to a device and/or system for locating and monitoring goods, chattels and the like. The invention relates to a locating and sensing device having a sensor, a transmitter and a receiver and, in particular, to a shipping container incorporating the locating and sensing device therein.

BACKGROUND OF THE INVENTION

[003] Frequently, when goods or chattels are damaged during shipment, insurance liability disputes arise. There is a great deal of uncertainty as to the exact time and the exact location of the package at the time that the damage occurred. Typically, the package to be shipped is either picked up by a package carrier such as United Parcel Service (UPS), Federal Express or any other transportation company, or brought to a central location managed by the package carrier. The package is assigned a tracking number and is scanned into a tracking database using a means such as a bar code scanner. The package is then tracked throughout its journey at specific checkpoints, such as delivery trucks, storage warehouses or routing stations. However, there is no means to monitor the condition or treatment of the package between the specific checkpoints. Consequently, packages arrive at their destinations in

damaged condition and it is extremely difficult to ascertain whether the package was damaged prior to shipment, during shipment or in the recipient's own mailroom.

[004] Moreover, it is frequently necessary to ship perishable items such as food, biological materials, botanical items and even critical items such as transplantable organs. Items such as these are often required to be maintained at certain minimum temperatures or other conditions during shipment in order to be usable upon arrival at the recipient's location. Once again, if these perishable items become unusable during shipment due to variations in temperature, it is difficult to ascertain the exact location and the exact time that a temperature change occurred that affected the perishable item.

[005] Accordingly, it is desirable to provide a device and system that is capable of monitoring and storing the condition of the package or monitoring and transmitting the condition of the package, which condition is accessible by an end user.

SUMMARY OF THE INVENTION

[006] The present invention generally relates to systems, methods and applications utilizing the convergence of two or more of the following three technologies, namely, wireless positioning systems, wireless communications and sensor technology. In particular, one embodiment relates to a remote localization and sensing device that includes a sensor for determining or measuring a desired parameter, a receiver for receiving position data from the GPS satellite system, and a wireless transceiver for transmitting the measured parameter data and the position data to a central station. In another embodiment, the remote device is integral with a shipping container which may, but need not, include GPS or other localization capabilities. The present invention also relates to various applications and systems utilizing the capabilities of such a device.

[007] Other objects and features of the present invention will become apparent from the following detailed description, considered in conjunction with the accompanying drawing

figures. It is to be understood, however, that the drawings, which are not to scale, are designed solely for the purpose of illustration and not as a definition of the limits of the invention, for which reference should be made to the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[008] For a fuller understanding of the invention, reference is made to the following drawings, in which:

[009] FIG. 1 is a block diagram of a localization and sensing device, in accordance with an embodiment of the invention;

[0010] FIG. 2 is a block diagram of the components of a remote localization and sensing device, in accordance with an embodiment of the invention;

[0011] FIG. 3 is a process flow diagram , in accordance with an embodiment of the invention;

[0012] FIG. 4 is a front elevation of a shipping container having a remote monitoring and sensing device integrated therein, in accordance with an embodiment of the invention;

[0013] FIG. 5A is a is a front elevation of a shipping container having a remote monitoring and sensing device integrated therein, in accordance with an embodiment of the invention; and

[0014] FIG. 5B is a front elevation of a shipping container having a remote monitoring and sensing device integrated therein, in accordance with an embodiment of the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0015] The device of the present invention represents the convergence of three technologies, namely wireless positioning, wireless telecommunications, and sensor technology. As described in more detail below, such a device can be used to: a) monitor a desired parameter of a certain object, b) receive position information regarding the position of

the object, and c) transmit the parameter and position information wirelessly to a base station. or base station, which make the localization and sensor data accessible by an end user. The basic components that make up a localizing/monitoring system 150 of the present invention are depicted in Figure 1 and the components of an exemplary remote localization and sensing device 120 is depicted in Figure 2.

[0016] Referring to the drawings in detail, the various embodiments of the present invention will now be discussed. With reference to FIG. 1, the device 120 generally comprises a receiver 400 for receiving position data from a wireless positioning system 100, such as the Global Positioning System (GPS). The device also includes a sensor 440 for receiving, determining or measuring a desired parameter of an object 180, and a wireless transceiver 420 for transmitting the parameter data and the position data to a base station and for receiving signals from the base station. The device may also include a modem.

[0017] The Object, which is being monitored, 180, the GPS Satellite System 100 and the Base station 280 form no part of the device as that term is used herein. The term wireless positioning system as used herein means any system that can determine the location of an object wirelessly, such as, for example, the GPS system, as well as radio frequency or other triangulation, ground based positioning systems utilizing field strength measurements and directional receivers, GPS-assisted, and the like. The term wireless telecommunications as used herein includes, now known and hereafter developed technologies, including, for example, cellular phone systems, two-way paging systems, wireless Internet connection systems and the like. Such wireless communications may be achieved using essentially any now known or hereafter developed protocol, including CDPD, CDMA, GSM, TCP/IP and the like.

[0018] The device 120 can be worn near or on the surface of an individual, animal or object 180, or can be implanted beneath the skin of an individual, animal or other object. In a

preferred embodiment of the present invention, the device 120 is adapted to be worn as a watch-like device on the surface of the skin of an individual. However, other configurations and placements are envisioned as a matter of design specific applications.

[0019] Various wireless transceivers 420 are commercially available, for example, Axiom's FMS-1000 analog system. The term sensor 440 as used herein includes any number of now known or hereafter developed sensors or transducers, including, for example, biosensors, magnetic sensors, temperature sensors, air quality sensors, humidity sensors, radioactive sensors, fiber-optic based pressure sensors, Force Sensing Resistors™ (FSR), piezoelectric sensors, capacitive touch sensors and mechanical sensors, to name a few. Various sensors are commercially available, such as, for example, temperature sensors manufactured by Sensor Scientific, Inc., i.e., type NTC, Model No. WM202C, which has a tolerance of plus or minus about 0.2 Deg. C, and Model No. SP43A which also has a tolerance of plus or minus about 0.2 Deg. C. Pulse rate sensors are available from Sensor Net Inc., Model No. ALS-230; Infrared optical sensors are available from Probe Inc; and Force Sensing Resistors™ (FSR) manufactured by Interlink Electronics.

[0020] Referring now to FIG. 2, with continued reference to FIG. 1, the device 120 of the present embodiment will be described in greater detail. It is to be understood that the present invention encompasses any number of configurations and implementations for the device middle tier and back office/back end, including those disclosed in International Application No. PCT/US01/48539, filed on October 29, 2001, and published on June 6, 2002 under publication no. WO0244865, which is hereby incorporated herein by reference. In one embodiment, as shown in FIG. 2, the device 120 includes a power source 210, such as a self-charging battery, a multi-channel A/D converter 220, a memory module 290 and a microprocessor 250. The battery 210 can be used to power the various components of the device 120 such as the GPS receiver 400, the microprocessor 250 and the memory module

290. Various batteries are commercially available, such as a thermal electric battery from D.T.S. GmbH, Model No. LPTG, as well as photo-electric batteries which are available from numerous manufacturers. The A/D converter 220 can be used to convert the sensor data for transmission by the transceiver 420, and can also be used to convert data received at the transceiver 420 from the sensor 440. The microprocessor 250 may be, for example, a MEM or ASIC based DSP, for storing the sensor data and/or the position data for transmitting by the transceiver 420 by way of a wide-band antenna 330.

[0021] An exemplary basic operation of the device 120 will now be described although it is within the scope of the invention for the device to operate as disclosed in the aforementioned International Application, which is incorporated herein by reference. The receiver 400 on the device 120 is in one-way communication with the GPS satellite system and receives position data from the GPS satellites 100 via antenna 310. The sensor 440 receives data regarding a particular parameter of the object 180 or environment which is to be monitored. The position data and/or the sensor data are sent or are otherwise available to the transceiver 420 for transmission to the base or ground station 280. In certain applications, the position and/or sensor data are first stored and then transmitted.

[0022] The base station 280 wirelessly transmits an interrogation signal to the device 120, with which the base station 280 is in two-way wireless communication. In response to the interrogation signal, the device 120 wirelessly transmits information relating to the physical location (position data) and/or the parameter of the object 180 being monitored (sensor data). Further information can be sent that is stored in the memory module 290 of the device 120 such as, for example, identifying object information. The base station 280 sends information relating to information received from the device to a central unit. The information received by the central unit can ultimately be stored, displayed, printed, processed or sent to other central units in a network or the Internet, for example.

[0023] The central unit, which may be located in a hospital, pharmaceutical company, a monitoring center or home, for example, may make the request for information periodically or aperiodically, for example, by a manual intervention or a command triggered by a particular circumstance. Furthermore, the central unit may be in wire-to-wire or wireless communication with the base station.

[0024] In light of the information received by the central unit, an automatic, semi-automatic or manual response may be needed. For example, upon reviewing the information received by the central unit, a doctor may diagnose a condition and/or a substantial deviation in a biological parameter of a person and authorize activation of a medical response. Alternatively, after analyzing the information received by the central unit, a program being run by the central unit may ascertain a particular condition (e.g., myocardial infarction) and/or an above-threshold deviation in a biological parameter (e.g., substantial restriction in blood flow) of a person and authorize an ambulance to be dispatched to the person's location immediately. As described below, the monitoring for alarm conditions extends to non-medical applications, such as the monitoring of shipping containers.

[0025] In another embodiment according to the present invention, the device 120, without the receipt of the interrogation signal from the base station 280, periodically sends information to the base station 280. Information relating to the received information is sent by the base station to the central unit. In yet another embodiment according to the present invention, the device 120 sends information to the base station 280 in response to a particular circumstance monitored by the device 120 or in response to a manual command by the person being monitored. For example, the device 120 may send information to the base station 280 in response to a particular biological parameter which may be indicative of a dangerous medical condition. In another example, the device 120 sends information to the base station

280 in response to a manual actuation of a switch or a specifically programmed button by the person.

[0026] The processing of data relating to, for example, the physical location and/or the parameters of the object 180 being monitored may occur either in the device 120, the base station 280, the central unit or some combination thereof. For example, the device may receive position data from the GPS. The data may be processed by the device itself before sending the calculated physical location to the base station. Alternatively, the position data received by the device 120 may be sent to the base station 280, which processes the information and calculates the physical location of the object 180, the calculated physical location of the object being sent to the central unit. In yet another alternative, the position data is sent to the device which sends the information to the base station which, in turn, sends the information to the central unit. In this embodiment, the central unit processes the position data and calculates the physical location of the object. Furthermore, the present invention contemplates a distributed processing scheme in which part of the processing of the information received by the device is processed, in part, by a combination of the device, the base station and/or the central unit.

[0027] Further methods of operating the device are described below with respect to certain design specific applications for a device of the present invention. The applications for such a device are widespread and limitless. A number of representative examples of systems embodying the device of the present invention are detailed below. A more detailed description of the various components of the device are also detailed below.

[0028] One particular application is directed at locating, monitoring and/or tracking food or other perishable items transit. The basic components of the system are depicted as shown in Figure 3.

[0029] As seen on the attached Figure 3, the system comprises a truck 140'' or other food container having a food item 180' therein. The truck 140'' is equipped with a device 120 mounted or otherwise installed thereon. In this particular application, device 120 comprises a wireless positioning receiver 400, such as a GPS receiver, a wireless transceiver 420 and a sensor 440. Sensor 440 may be any type of sensor applicable to measuring, tracking or confirming a parameter related to the quality of food item 180' such as, for example, a temperature sensor, humidity sensor or gas sensor to name a few. Sensor 440 is coupled to, transmits or otherwise makes such data available to device 120, and in particular, transceiver 420 of device 120.

[0030] Device 120 is in two-way wireless communication with a ground station 200', which is in turn in two-way communication with a base station 280. base station 280 is in two-way communication with a computer network, such as the Internet 300. Internet 300 is in two-way communication with a number of individual networks, computers or other devices, such as, for example, transportation company 320, food producer 340, customer 360 or a government agency 380, to name a few. The communications between the various systems, i.e., transportation company 320, food producer 340, customer 360 or a government agency 380 can be wireless or direct connection as a matter of application specific design choice. In any event, the various systems can access and communicate with base station 280 and, in turn, with device 120 on truck 140''.

[0031] With continued reference to FIG. 3, the basic operation of the system will now be described. As food item 180' is placed on a truck 140'' or other shipping container 140'. A device 120 is placed on or near food item 180'. The actual physical location of device 120 in relation to food item 180' is immaterial, so long as sensor 440 of device 120 can adequately monitor the desired parameter of food item 180'. In certain embodiments, the device is integrated in the container as described in connection with FIGS. 4-5B herein.

Sensor 440 gathers or otherwise determines sensor data relating to the parameter to be monitored. This sensor data is stored by, or is otherwise accessible to, device 120 and, in particular, transceiver 420. GPS receiver 400 receives data from GPS satellite 100. The GPS data, as well as the sensor data, is available to transceiver 420 for wireless transmission to ground station 200'. Ground station 200' in turn makes this information available to base station 280 and to Internet 300, upon which such information is available to authorized end users.

[0032] The information can be transmitted to base station 280 either, for example, periodically, by request of an end user, or by request of the driver or operator of truck 140'', or as described in the aforementioned International Application, to name a few. Other data is also available to base station 280, such as, for example, the location of truck 140'', its speed, distance traveled, time since departure, time to arrival, etc.

[0033] It is desirable for various end users and/or authorized officials to be able to track or monitor the safety and/or quality conditions of food in transit. The system of the present invention provides such a means. For example, a customer 360 of food item 180', who has been given an appropriate password or other security device, can log on to the base station 280 via a computer network, such as the Internet 300. Customer 360 can, in real time, determine where their food shipment is in transit, can check or monitor the condition or quality of the food item in transit, can monitor the distance traveled by the food item 180', and can estimate, in real time, the time of arrival of the food item 180'. The transportation company 320 can similarly monitor the quality of the food item 180', track the amount of time the truck 140'' and/or driver have been in transit, monitor the speed the truck 140'' is or has been traveling at, and estimate, in real time, when the truck should arrive at the customer's location. Similarly, the food producer 340 can monitor the quality of the food in transit should a dispute arise with either the customer 360 or the transportation company 320

or others. In fact, the system will permit each party to document the quality of the food item 180' at each stage in the delivery process. Such documentation may serve as a "Stamp of Approval" that the food item was maintained in a safe condition while in its possession. Finally, an appropriate government agency 380 can also monitor, in real time, the quality of the nation's food supply, as well as monitoring the time the particular driver and/or truck 140'' have been in transit should any problems or accidents occur. In any event, each of the parties involved can monitor the quality of the food item 180', in real time, while it is in transit.

[0034] Various modifications, additions or substitutions of the components described above could be made. For example, while the system has been described as a system for monitoring food on a truck, the system would work equally well as a system for monitoring the quality of food on a train or on an aircraft. Similarly, the system could monitor various parameters that might be important to the shippers of various valuable items such as artwork, pharmaceuticals and the like, where the humidity and temperature within the container may be important factors.

[0035] As noted above, in certain other embodiments, which will be described with reference to FIGS. 1-4, the remote monitoring and sensing device 120 is integral with a shipping container 140'. In certain of such embodiments, the shipping container is constructed of cardboard, plastic, or any other materials suitable for transport. In one such embodiment, the device 120 is integral with a package container suitable for being transported by existing courier or transportation service, including those offered by the US Postal Service, United Postal Service, Inc., Federal Express Corporation (FedEx), and the like. Such embodiment provides both real-time and historical monitoring of shipping conditions, including the various sensory data. Because couriers typically have package tracking logistics in place, such integral device need not have a GPS transceiver or other

localization technology. However, localization technology may be utilized, in which case the localization data (both real-time and historical could be provided to the base station 280 and thus, the end user). The system 150 also provides alarm notification to the courier and/or customer 360 of any undesirable conditions, such as excessive temperature, excessive shock to the shipping container 140', misrouting or any other condition defined by the courier and/or customer 360. Such alarm conditions are stored in the computer system of the base station 280 for each courier/customer. The courier and customer may log into a secure web site provided by the base station or call into a call center to obtain the real-time and historical data.

[0036] In certain embodiments, the remote device 120 stores the data in the memory 290 residing thereon until an appropriate time for uploading such data. For example, should the device 120 detect that the communication signals are too weak for transmission, the device would automatically store the data in the memory 290 for transmission upon restoration of the communication link between the device 120 and the base station 280. Alternatively, the data could be stored until a confirmation signal is received from the base station 280 indicating that the data was successfully received.

[0037] As such, in certain applications, the sensors 440 integral with the container 140' are preferably for measuring at least: the temperature internal to the container, physical shock absorbed by the container, and the existence or loss of a vacuum condition within the container 140' and/or its wall construction.

[0038] The sensor 440 for determining the physical shock preferably consists of at least one planar accelerometer (or alternatively, two or more uni-directional accelerometers) whose output is monitored and interpreted locally by a processing element of the monitoring and sensing device 120 or could be transmitted to the base station 280 where such output could be monitored and interpreted by a server or other processing element. The planar

accelerometer detects changes in orientation of the container 140', as well as acceleration/deceleration of the container in the two direction defined by the plane being measured. Thus, for example, if the container were to fall from a shelf while in transit, the accelerometer would measure an abrupt acceleration and an abrupt deceleration. A change in orientation could also be detected. Any of these conditions or any combination of such conditions could trigger an alarm and corresponding notification to the courier and/or customer.

[0039] In other embodiments utilizing magnets, one couples the first part of the vacuum sensor to the vacuum chamber wall (as described above) and one couples the second part of the sensor to the rigid outer wall. In one such embodiment, the magnets are positioned to attract each other, thereby providing accurate location of the vacuum sensor parts. In another such embodiment, the magnetic forces between the magnets (either attraction or repulsion) are used as part of the sensor itself. While the vacuum exists, the vacuum chamber walls and outer rigid wall (and thus the magnets) are separated a certain distance; when the vacuum is removed, the force of the magnets acts to change the degree of separation between the vacuum chamber wall and the rigid outer wall (either closer together when the magnets are oriented to attract each other or farther apart when the magnets are oriented to repel).

[0040] Referring now to FIGS. 5A and 5B, with continued reference to FIGS. 1-4, as noted above, certain embodiments utilize a container having an inner chamber that is in a vacuum condition. For example, such a container may have a rigid outer wall constructed of plastic, fiberglass or similar material or a combination thereof, and a flexible inner chamber from which air is removed to create a vacuum condition. It is to be understood that the scope of the present invention is not limited to use of any particular material and, as such, encompasses now known and hereafter developed materials. Monitoring the existence or loss

of a vacuum condition within the container may be achieved by any number of different types of sensors, including, for example: pressure sensor, for detecting a change of pressure within the vacuum chamber; audio sensor for detecting the noise caused by the airflow into the vacuum chamber when the vacuum is lost; a flow meter for detecting air flow in the container when the vacuum condition is lost, and the like. In one embodiment, as shown in FIG. 5A, a mechanical sensor 460, detects the change of volume of the vacuum chamber when the vacuum condition is lost. The flexible inner wall 470, having an actuator 430 mounted thereto, and corresponding to a mechanical sensor 460 which is mounted to the rigid outer wall activates the sensor when the flexible inner wall 470 expands towards the rigid outer wall 450 due to the loss of vacuum. In certain embodiments using the foregoing sensor arrangement, the flexible inner wall is supported by a frame comprised of wire, wood, plastic or other material. Such frame may be, by way of example, along some or all of the edges of the flexible chamber. In other embodiments, the device utilizes detection of a gas with known properties escaping from a generally air-tight inner chamber, or entering the chamber.

[0041] In an alternate embodiment, depending on the type of vacuum sensor, the remote monitoring and sensing device may be located internal to the vacuum chamber, between the vacuum chamber and the rigid outer wall, exterior to the rigid outer wall, or any combination thereof. The vacuum sensor may also utilize one or more magnets to locate the sensor and/or as part of the sensor. In one embodiment shown in FIGS. 5B and 5C, the vacuum chamber comprises a rigid wall or frame surrounded by a flexible, airtight layer. A "north" pole magnet 510 is positioned on the inner surface of the flexible wall 470 and affixes a vacuum sensor actuator to the outer surface of the flexible wall 470. The rigid wall 450 includes an indentation for accommodating the "north" pole magnet 510. When the vacuum condition is lost, the flexible wall 470 is no longer held taught, and the "north" pole magnet 510 is drawn into the indentation by the magnetic pull of a "south" pole magnet 520

mounted to the rigid wall 450. A vacuum sensor 530 affixed to the rigid wall detects movement of the vacuum sensor actuator 540, thereby detecting loss of vacuum.

[0042] Another embodiment utilizing a vacuum sensor and indentation in the outer wall is shown in FIG. 6A and 6B. As illustrated, the device 120 is positioned on the outer surface of the outer wall 450, with electrically conductive leads extending through the wall 450 to two spaced-apart contacts C1 and C2. The device 120 includes a detection circuit for detecting when the circuit across the two contacts C1 and C2 is closed. A magnet 520 is also position on the wall 450. In certain embodiments, the magnet 520 is covered with a dielectric material.

[0043] On the outer surface of the flexible inner container wall 470 (the inner container being in a vacuum state) is a third electrical contact C3. On the inner surface of the flexible wall 470 is an oppositely poled magnet. The third contact C3 is positioned relative to the first two C1 C2 so that it may close the circuit when drawn towards the outer wall 450 in the absence of a vacuum condition, as illustrated in FIG 6B. FIG. 6A illustrates the components when the vacuum condition exists.

[0044] It should be understood by those skilled in the art that in the foregoing embodiments the polarity of the magnets may be interchanged and that each embodiment may be modified so as to interchange the placement of the magnets on either the inner or outer surface of the container walls. Furthermore, the indentation need not be used, although it presence aids in alignment and directing movement of the components. Lastly, the device components may be oriented on any side of the shipping container 140 (e.g., side, top, bottom).

[0045] Certain shipping conditions may hamper transmission of the location and sensor data from the remote device to the base station. For example, devices may not be able to transmit from inside metal containers, such as an aircraft hold. In such circumstances, an

external "repeater" could be used to receive wireless data and/or alarms in selected cellular telephone format (e.g., CDPD, GSM, CDMA and the like) and translate them into satellite phone format for transmission using an antenna external to the metal hold.

[0046] In the case of an aircraft hold, the "repeater" could have a pre-connection to the craft's electrical system, thereby providing sufficient power for use of the aircraft's satellite transmission system or other transmission system. Once the container was out of the hold, it would presumably be located within range of wireless cellular infrastructure.

[0047] In other embodiments, a wireless RF link is used to broadcast location, sensor and/or alarm data. Such transmission could communicate directly with the courier's own infrastructure or a third party's infrastructure.

[0048] It is also preferable for the remote monitoring and sensing device 120 and container 140', on one hand, to have an identification number (ID) associated with the ID provided by the courier (i.e., the shipping ID). In this manner, the monitoring and sensing information collected by a remote device can be associated with a shipment and particular customer. Such association may be achieved in any number of manners and is preferably ultimately stored in a database at the base station. An example of the steps that may be followed is depicted below:

[0049] Step 1. Customer places phone call to an automated system or connects to a secure web site via the Internet or other network, and keys in both the container/device ID number and the Shipment ID number. The back end software then knows this particular container has embarked on a shipment and the time/date of pickup. It knows everything a package carrier like FedEx would know about the package, but we only need "shipment started," for this particular container and time stamp.

[0050] Upon arrival, another similar phone call can be made to activate the base station to interrogate the container (telling it, in effect, "shipment over') for wireless cellular communication of the sensor data/history.

[0051] Step 2. Alternative to the above container memory usage, it can be programmed to keep track of a number of days worth of data, with a buffer size larger than necessary. For example, six days worth of data is probably longer than any shipment will be.

[0052] Regardless of the frequency of sampling, the buffer can drop the oldest day's data when a new day's (in certain embodiments as daily average) is ready to be posted in the buffer. In this situation, at any time the data are wirelessly downloaded, the backend base station software can determine shipment start and stop from the Shipment ID. This saves some power at the beginning of a shipment because some telecommunications can be avoided, but data processing is a bit different.

[0053] A shortcoming of this method is it complicates the logic of alarms when the container itself does not "know" if it is in a state of being shipped. A way to ensure the base station identifies the proper state and/or location of the package, is to program the container to interpret certain temperature changes (e.g. drops) as signaling the start of a shipment, or to utilize another predetermined condition (e.g., certain pitched sound; light of certain frequency and the like). The device 120 sense the predetermined condition and transmits the data to the base station, which interprets the data.

[0054] Step 3. Pickup and delivery drivers of some shipping companies (such as FedEx) normally scan a bar code at the beginning and end of a shipment. The bar code contains the Shipment ID, and is printed by the customer on labels provided by the shipping company utilizing software also provided by the shipping company. A "permanent" identifying bar code can be manufactured into or added to the surface of each container, encrypting its modem ID (container ID) and other information. Upon the driver (or other)

scanning both bar codes, the shipping company's backend software could connect with DA's to tell DA's that a certain specific container is being shipped. Data can then be processed and alarms enabled accordingly.

[0055] Step 4. The container ID bar code could also appear in a location at which it is scannable through a hole manufactured into the label printed by the customer. This could keep it to a single scan.

[0056] Step 5. The container ID could also be encrypted into the shipping ID bar code by customer data entry into the label-generating software, where permitted by the shipping company's software.

[0057] Step 6. If the shipping company can revise its scanning hardware, the container can have built-in RFID (active and/or passive) to provide (via the scanner) its identity to the back end.

[0058] Step 7. The shipping ID could be entered wirelessly to the container by wireless RF link, and could interpret said entry to be the start of a shipment.

[0059] Step 8. There could be a keypad on the container to enter the shipping ID, which the box would then link to its container ID, and interpret said entry to be the start of a shipment.

[0060] Additionally, there could be a function and/or on/off button on the container. Also customer or shipping company driver could use a remote control for this, probably RF. If a display is also used on the outside of the container, the last temperature displayed (i.e. "temperature on arrival") could be updated only be a predetermined sampling interval and never updated when the container is open. This is to prevent the last temperature from reflecting an open container. The container could also incorporate an alarm for unauthorized opening. A vibrational/shock history could also be stored in the memory 290 and transmitted by the transceiver 420 of the container 140', in addition to alarms.

[0061] Thus, while there have been shown and described and pointed out fundamental novel features of the invention as applied to preferred embodiments thereof, it will be understood that various omissions and substitutions and changes in the form and details of the disclosed invention may be made by those skilled in the art without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the claims appended hereto.

CLAIMS

WHAT IS CLAIMED IS:

1. A localization and sensing device for tracking and monitoring a condition of an object, comprising:

a wireless positioning receiver for receiving positioning data from a wireless positioning system;

a wireless transceiver for transmitting said positioning data to a base station whereby making said positioning data available to an end user; and

a sensor for monitoring a desired parameter of said object, wherein said sensor transmits parameter data to said wireless transceiver, wherein said wireless transceiver transmits said parameter data to said base station to make said parameter data accessible to an end user.

2. The localization and sensing device of claim 1, wherein the base station is a base station.

3. The localization and sensing device of claim 1, wherein the wireless positioning system is a Global Positioning System ("GPS") which provides instantaneous location data for said object.

4. The device of claim 2, wherein said base station is continually attached to the Internet for end user accessibility.

5 A localization and sensing system for tracking and monitoring a condition of an object, comprising:

a GPS receiver having a Patch antenna for receiving position data from a GPS satellite;

a transceiver having a wide-band antenna for wireless transmission of position data and parameter data to a ground station for accessibility by end users;

a microprocessor for storing sensor data for transmitting by the transceiver, said microprocessor capable of simultaneously storing position data for transmitting by the transceiver;

a multi-channel analog-to-digital converter ("ADC") for converting the sensor data for transmission by the transceiver;

a memory module for storing data from the microprocessor; and

a sensor for monitoring a desired parameter of said object, wherein said sensor transmits parameter data to said wireless transceiver, wherein said wireless transceiver transmits said parameter data to said base station to make said parameter data accessible to an end user.

6. A localization and sensing system of claim 5, further comprising a power source, wherein said power source can be used to power said localization and sensing system.

7. A localization and sensing system of claim 5, wherein said sensor is selected from the group consisting of biosensors, magnetic sensors, temperature sensors, air quality sensors, humidity sensors, radioactive sensors, fiber-optic based pressure sensors, Force Sensing Resistors™ (FSR), piezoelectric sensors, capacitive touch sensors and mechanical sensors.

8. A localization and sensing system of claim 5, wherein said microprocessor is a MEM based DSP.

9. A localization and sensing system of claim 5, wherein said microprocessor is an ASIC based DSP.

10. A method of monitoring and tracking a food item during shipment, comprising the steps of:

loading a food item on a truck;

place a localizing/sensing device on or near the food item, said device having a sensor for gathering parameter data;

enable the transceiver to transmit the parameter data to a ground station;

connect the ground station to the Internet through an; and

provide end users with monitoring access to the food item in transit.

11. The method of claim 10, wherein the:

end users are selected from a group consisting of customers, food producers, transportation company personnel and government agents.

12. The method of claim 10, wherein the:

localizing/sensing device comprises a wireless positioning receiver, a microprocessor and a memory module for storing the parameter data.

13. A shipping container having a localization and sensing device for tracking and monitoring a condition of an object during shipment, comprising:

a rigid outer wall for providing stability to the container having a sensor disposed thereon;

a flexible inner wall capable of being vacuum sealed having an actuator disposed thereon for pressing the pressure sensor if the vacuum seal fails;

a wireless positioning receiver for receiving positioning data from a wireless positioning system;

a wireless transceiver for transmitting said positioning data to a base station whereby making said positioning data available to an end user; and

a sensor for monitoring the vacuum seal in said shipping container, wherein said sensor transmits parameter data to said wireless transceiver, wherein said wireless

transceiver transmits said parameter data to said base station to make said parameter data accessible to an end user.

14. The localization and sensing device of claim 13, wherein the wireless positioning system is a Global Positioning System ("GPS") which provides instantaneous location data for said object.

15. The localization and sensing device of claim 13, wherein said base station is continually attached to the Internet for end user accessibility.

16. A container comprising:

an inner wall having disposed thereon a first sensor part;

an outer wall having disposed thereon a second sensor part, the first sensor part and second sensor part to detect a change in a condition of the container;

a third sensor part in communication with either the first sensor part or second sensor part for communicating externally the condition.

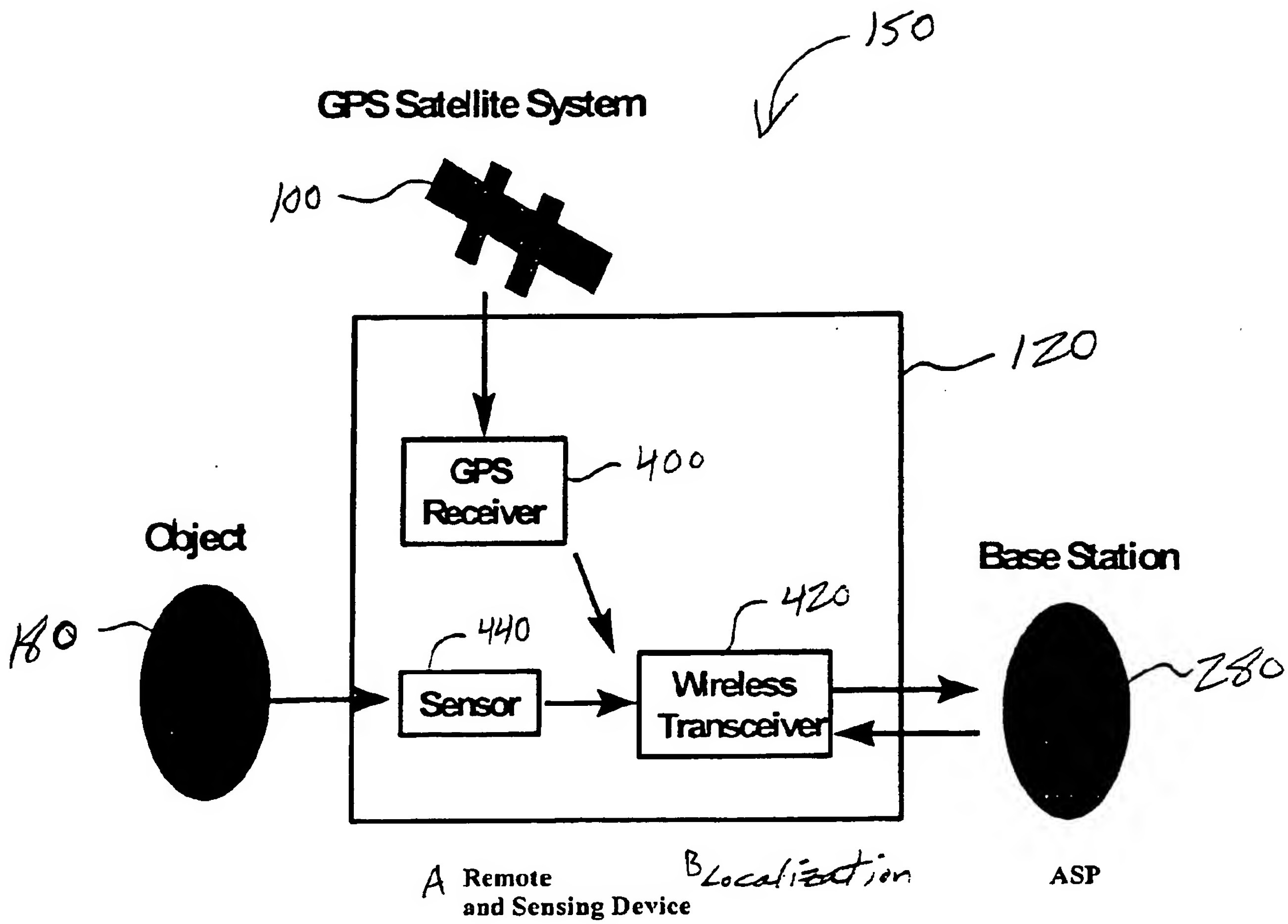
150
GPS Satellite System
100
120
GPS Receiver
400
Object
Base Station
420
440
180
Sensor
Wireless Transceiver
280
A Remote and Sensing Device
B Localization
ASP

FIG. 1

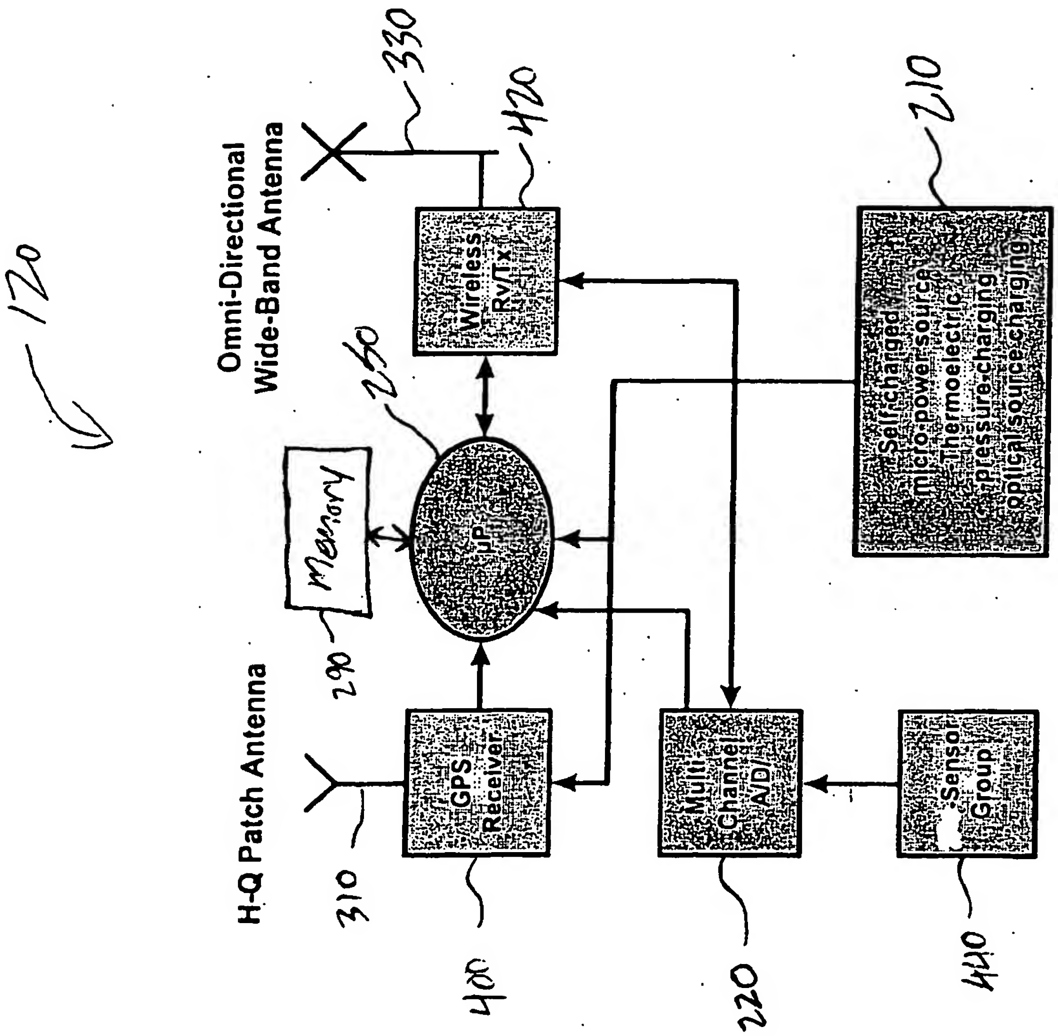
120
Omni-Directional Wide-Band Antenna
330
420
Wireless Rv/Tx
260
μP
Memory
290
H-Q Patch Antenna
310
GPS Receiver
400
Multi-Channel A/D
220
Sensor Group
440
Self-charged micro-power source thermoelectric pressure charging optical source charging
210

FIG. 2

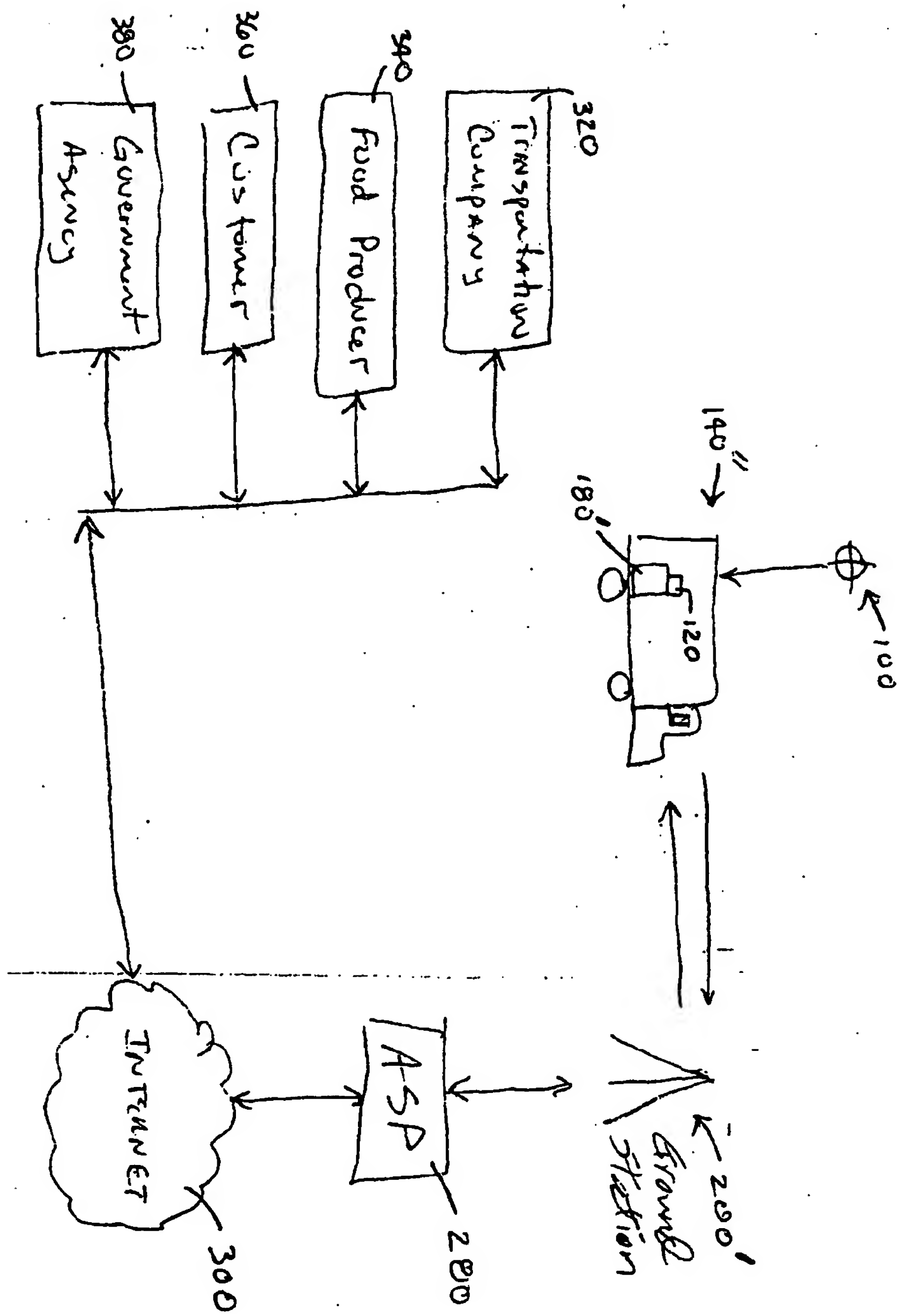
380
Government Agency
360
Customer
340
Food Producer
320
Transportation Company
140''
180'
120
100
INTERNET
300
ASP
280
Ground Station
200'

FIG. 3

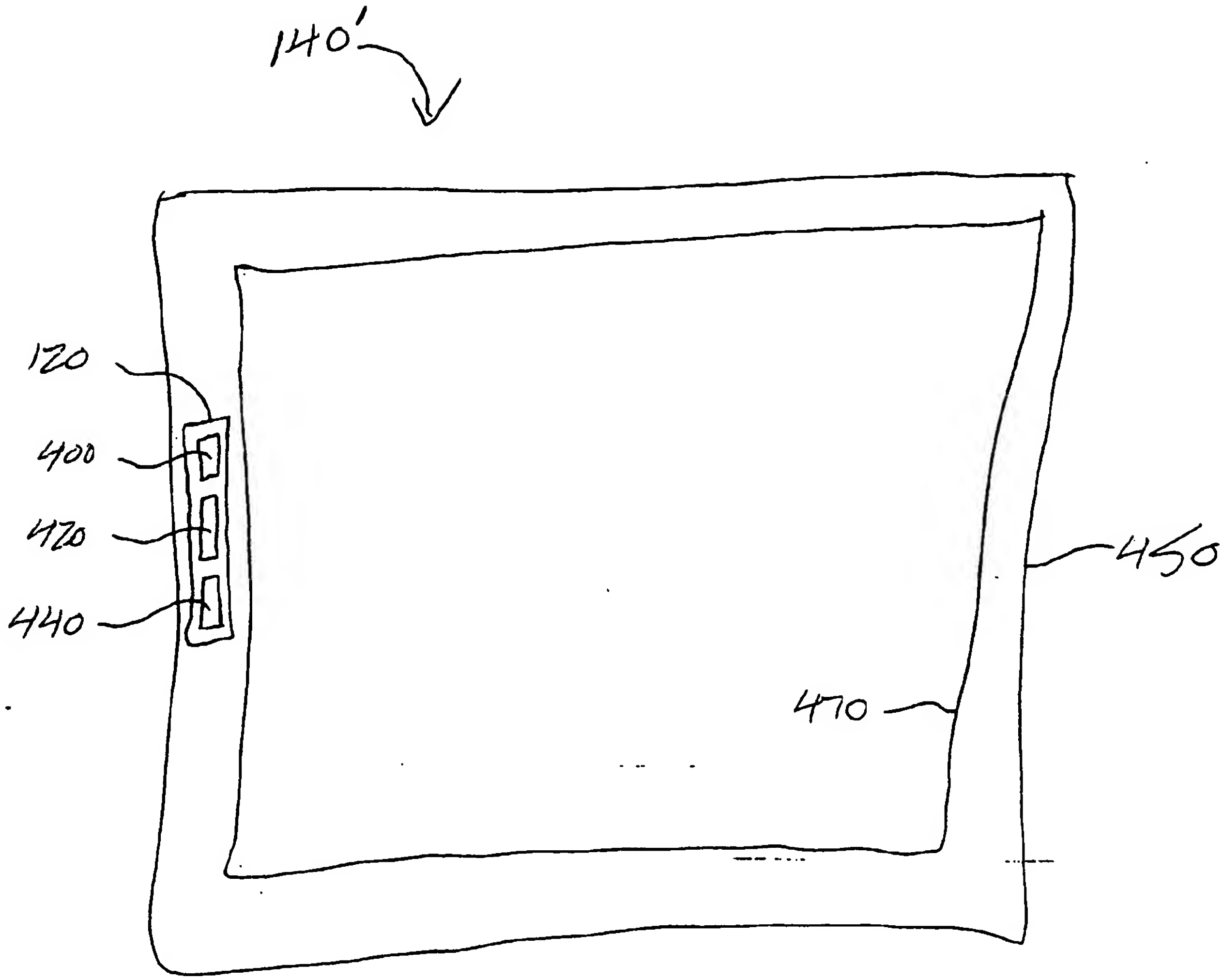

FIG. 4

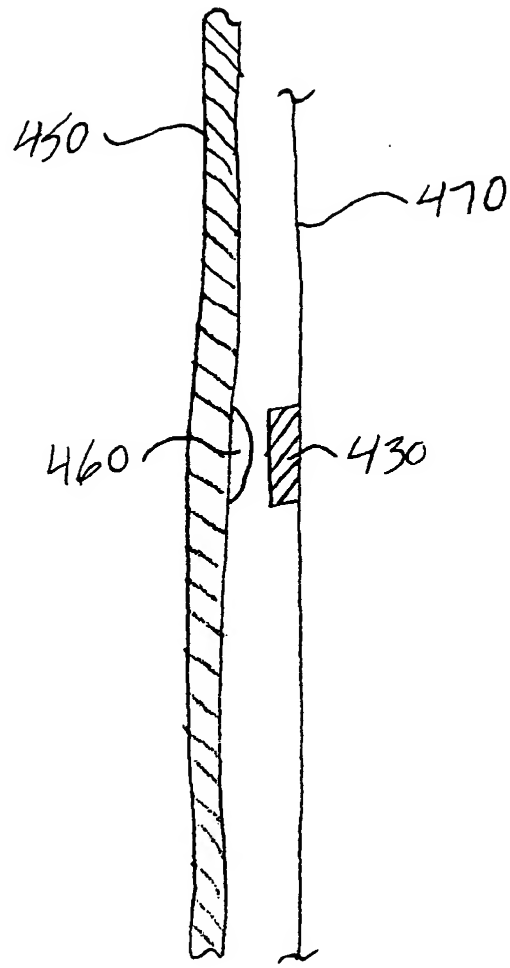

FIG. 5A

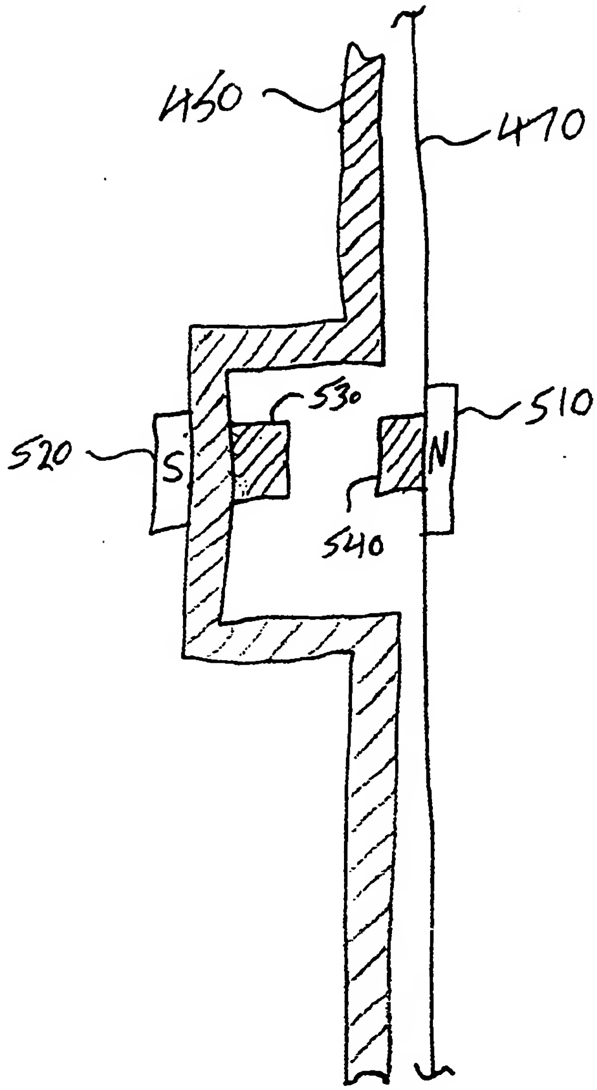

FIG. 5B

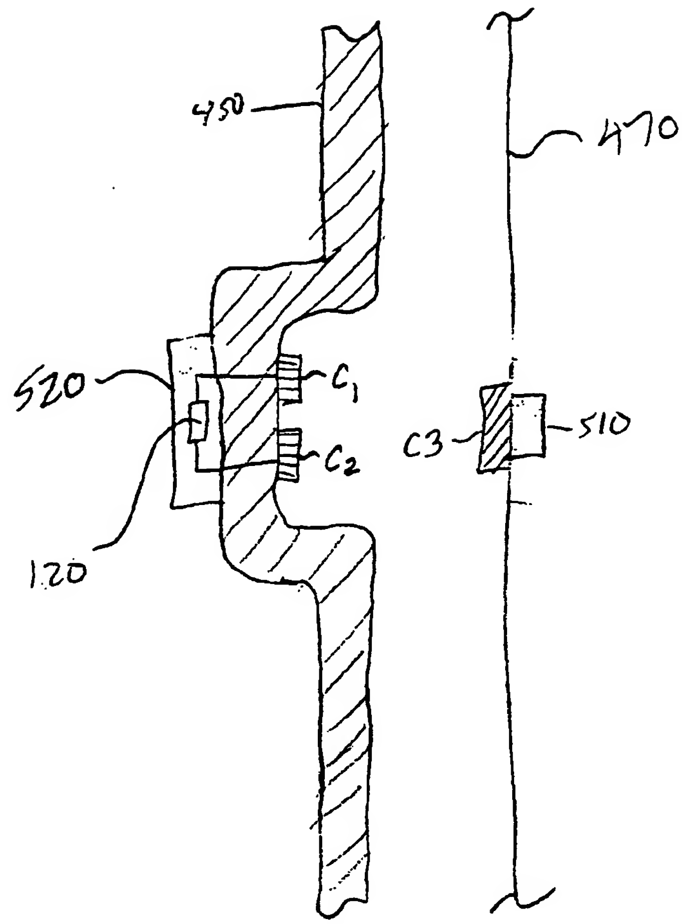

FIG. 6A

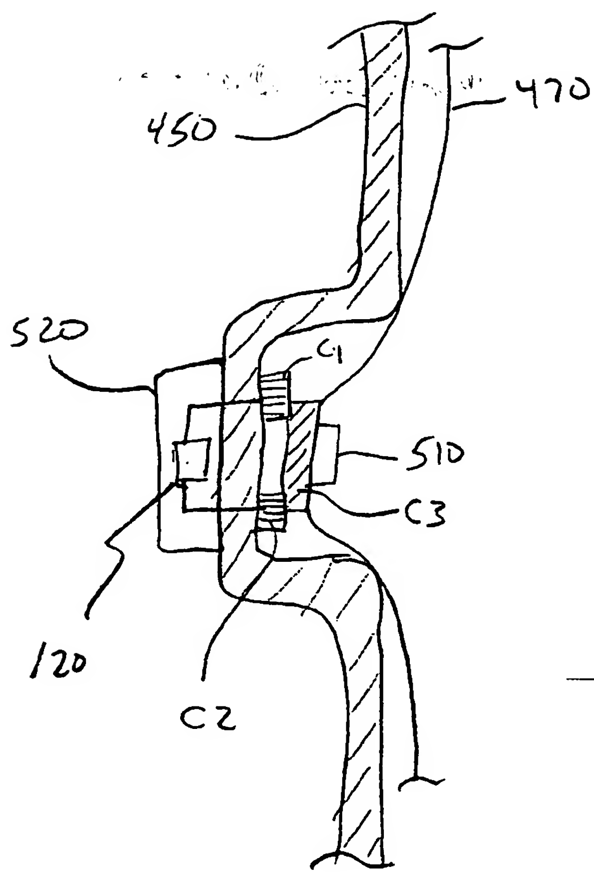

FIG. 6B